

Z(ee) + Jets Update

- Correction Factors vs Jet Multiplicity (EM, Tracking, Trigger)
- Jet Reconstruction Efficiencies
- Data vs MC
- todo



Samples

- **Data:**
 - EM1TRK skim
 - Single EM triggers
 - Run range: 20 April 2002 - 28 June 2004 (Runs 151,817 - 194,566)
 - Rejecting bad runs (CAL, SMT, CFT, Jet/Met, Lumi)
 - 323pb^{-1}
 - No t42 applied
 - Processed with ATHENA (v01-05-02)
- **MC:**
 - Z/Gamma^* → $e^+e^- + X$: 400k Pythia
 - $Zj \rightarrow ee j$: 150k Alp+Pythia
 - $Zjj \rightarrow ee jjj$: 180k Alp+Pythia
 - $Zjjjj \rightarrow ee jjjj$: generator files are stored in SAM, will be processed soon ...
 - Processed with ATHENA (v01-05-02)



Selection Criteria

- Removing bad runs/LBNs & dupli events
- PVX cut: $|z| < 60\text{cm}$
- Using unprescaled single EM triggers
- Electron selection:
 - $|\text{ID}| = 10, 11$
 - $\text{EMF} > 0.9$
 - $\text{Iso} < 0.15$
 - $\text{HM}_k(7) < 12$
 - $p_T > 25\text{GeV}$
 - Including phi cracks
- Z selection:
 - $75\text{GeV} < M_{ee} < 105\text{GeV}$
 - At least one trackmatched electron
 - At least one electron needs to fire the trigger
- Jet selection:
 - $0.05 < \text{EMF} < 0.95$
 - $\text{HotF} < 10$
 - $N_{90} > 1$
 - $\text{CHF} < 0.4$
 - $L1\text{conf}$
 - JES corrected $p_T > 20\text{GeV}$
 - $|\eta| < 2.5$
 - Removal of jets overlapping with electrons from Z within dR of 0.4

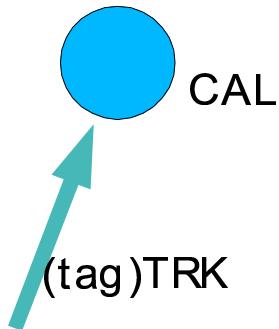


EM Efficiencies vs Jet Multiplicity

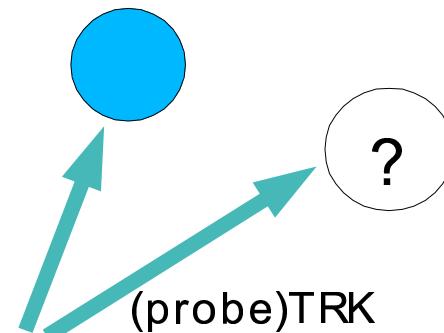


Tag & Probe Method

Tag:



Probe:



$PVX < 60\text{cm}$

Tag-Electron: $\text{EMF} > 0.9$, $\text{Iso} < 0.15$, $\text{HMx7} < 12$, $p_T > 25 \text{ GeV}$, $|\eta| < 1.1$, with phi cracks, matched with a good track in $\Delta R (< 0.14)$

Trigger: tag electron is required to have fired single electron trigger

Tag & ProbeTracks: $25 \text{ GeV} < p_T < 80 \text{ GeV}$, $\text{Chi2} < 8.0$, $|\text{DCA0}| < 0.3$, $|\text{DCA1}| < 4.0$, $|\eta| < 1.1$, with phi cracks

Probe: Good track separated from Tag by $d\phi > 2.0$

Background reduction: opposite signed tracks, $\text{MET} < 15 \text{ GeV}$, Sidebands

TagElec-ProbeTrack-invmass cut: $70 \text{ GeV} < M_{ee} < 110 \text{ GeV}$

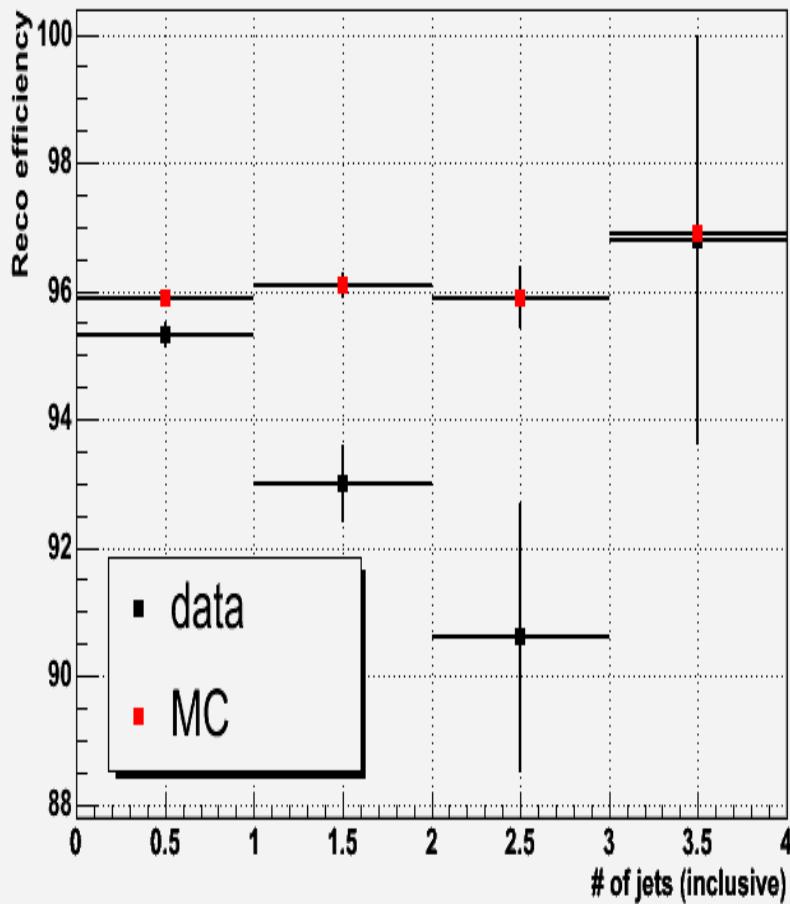
Reco matching cone: $dR = 0.14$

Jets: $0.05 < \text{EMF} < 0.95$, $\text{HotF} < 10.0$, $\text{N90} > 1$, $\text{CHF} < 0.4$, L1conf , $p_T > 20.$, $|\eta| < 2.5$, not counting jets overlapping with probe tracks within $\Delta R < 0.4$

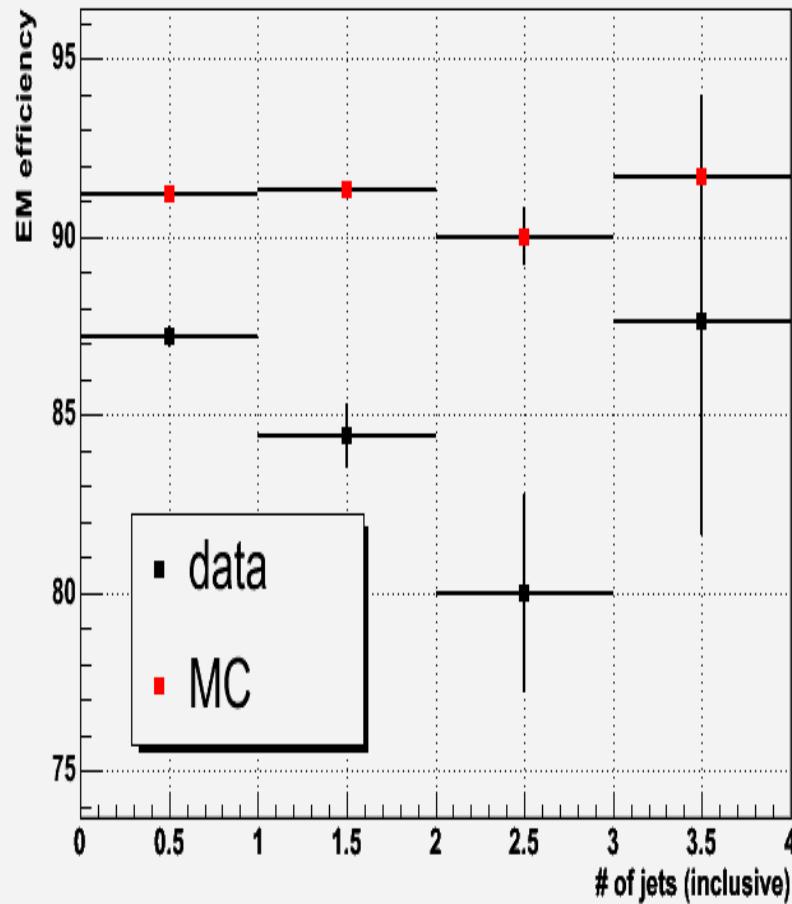
Averaged Reco & TotalEM Efficiencies vs Jet Multiplicity

Using averaged efficiencies for $\geq 1, 2, 3 \dots$ jets

Data vs MC: Reco efficiencies vs Jet Multiplicity

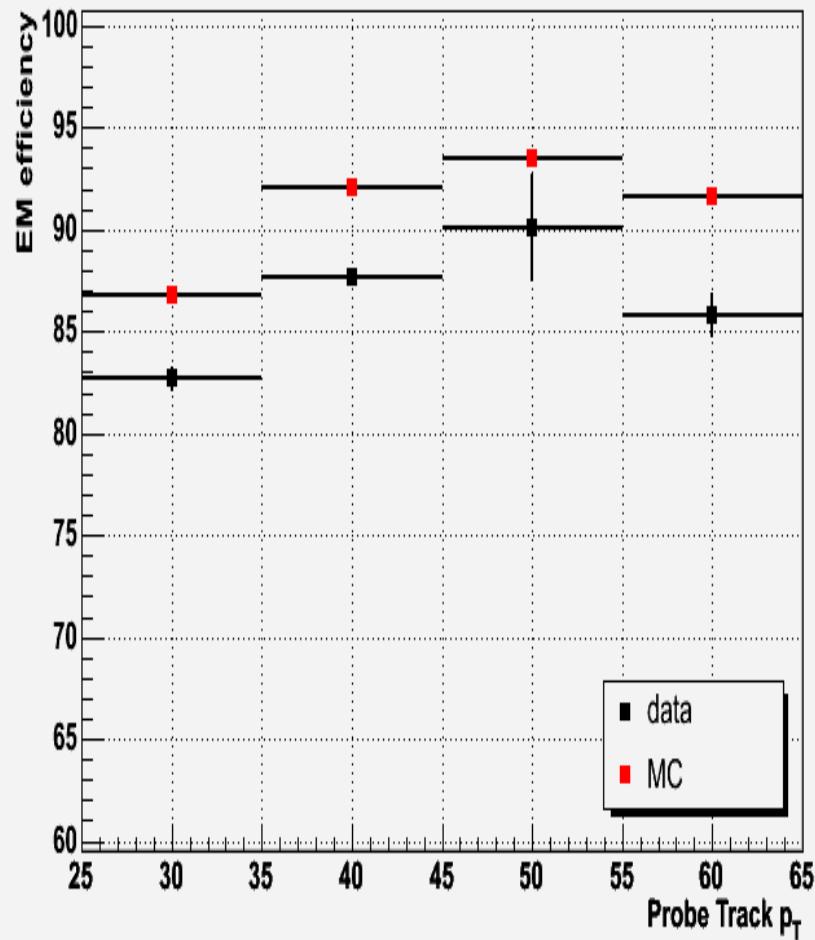


Data vs MC: EM efficiencies vs Jet Multiplicity

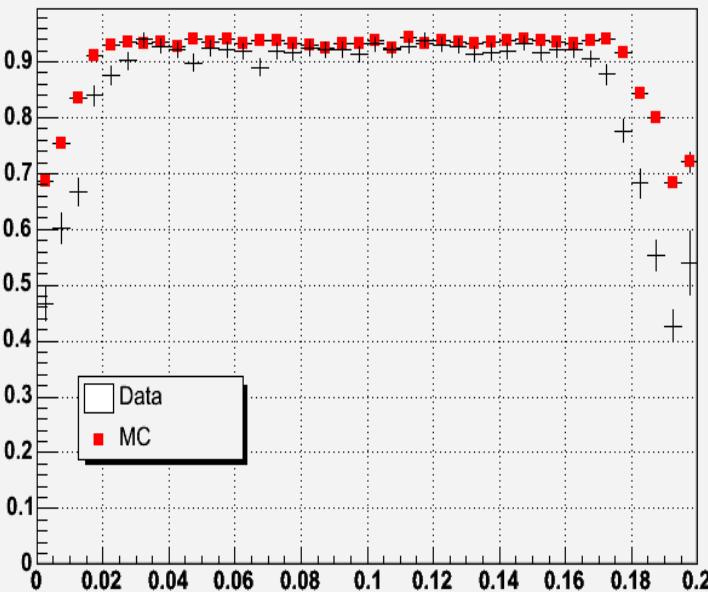


Parameterized Efficiencies (≥ 0 jets): pt & phi

Data vs MC: EM efficiencies vs pT (SB subtracted)



eff_EM_phi_0jet no sideband subtraction



with sideband subtraction:

| | data | MC |
|---------------|----------------------------------|----------------------------------|
| 'Flat region' | 91.9 \pm 0.2 | 93.5 \pm 0.1 |
| Phi cracks | 63.5 \pm 0.9 | 80.3 \pm 0.3 |

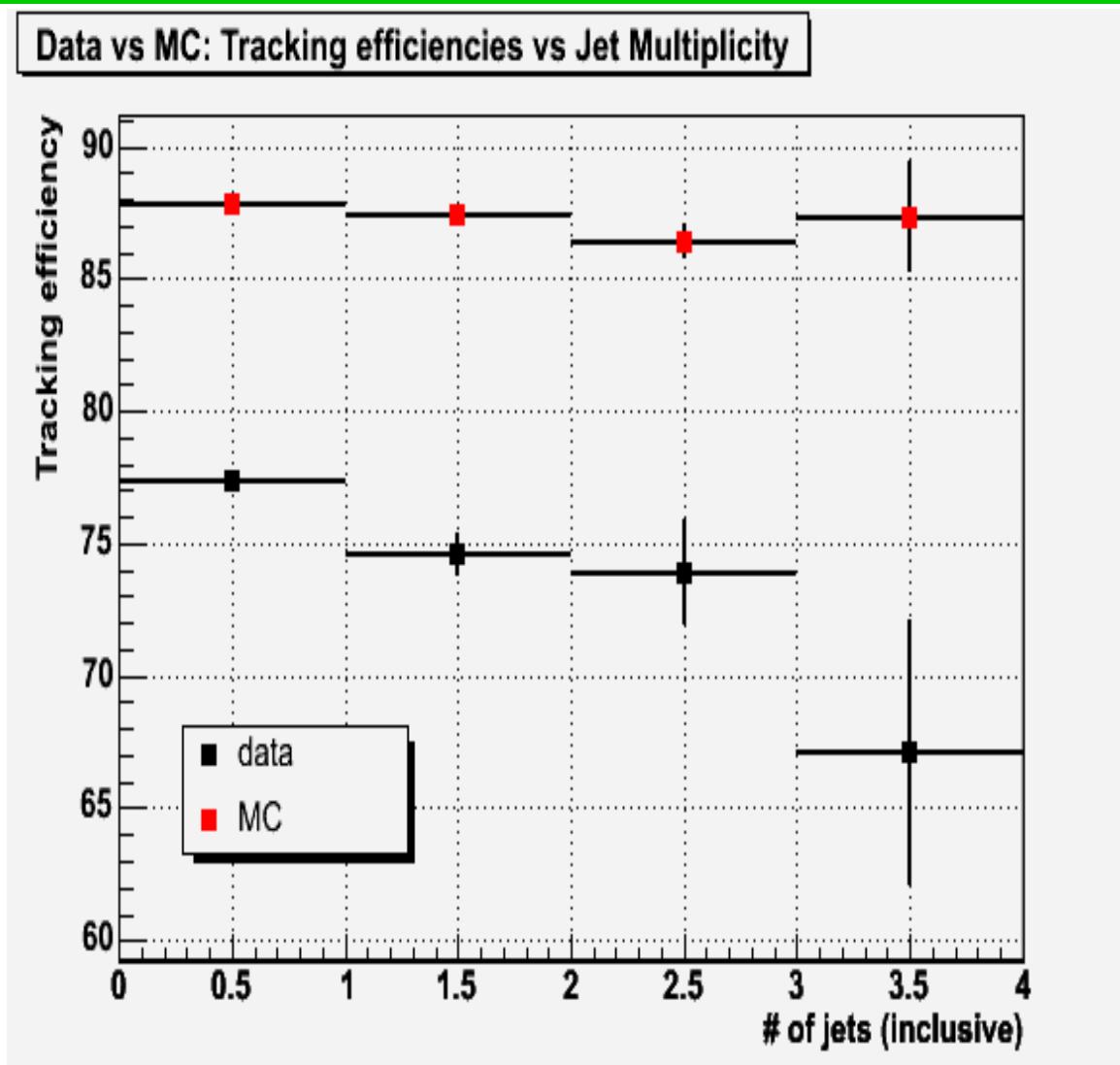


Tracking Efficiency vs Jet Multiplicity



Averaged Tracking Efficiency vs Jet Multiplicity

1. Plot dijet invariant mass distributions for 1 and 2 track match samples
2. Apply SB background subtraction
3. Estimate Tracking efficiency



Trigger Efficiency vs Jet Multiplicity



Single EM Triggers

- Using a combination of unprescaled single EM triggers
- For an event to be used, a candidate electron must fire one of these triggers
- Preferred order:
 - CMT 8 to 11 trigger combinations (runs ≤ 178721)
 - **EM_H_SH or EM_H_2EM5_SH**
 - **EM_H_SH**
 - **EM_H**
 - **EM_MX_SH**
 - **EM_MX**
 - CMT 12 trigger combination
 - **E1_SHT20 or E2_SHT20 or E3_SHT20 or E1_SH30**
 - **E1_SHT20 or E2_SHT20 or E3_SH30**
 - **E1_SHT20 or E3_SH30**
 - **E1_SHT20**



Single EM Triggers contd

| Trigger | L1 | L2 | L3 |
|---------------|------------------|----------|----------------------|
| EM_HI_SH | CEM(1,10) | EM(1,12) | ELE_LOOSE_SH_T(1,20) |
| EM_HI_2EM5_SH | CEM(2,5) | EM(1,12) | ELE_LOOSE_SH_T(1,20) |
| EM_HI | CEM(1,10) | EM(1,12) | ELE_LOOSE(1,30) |
| EM_MX_SH | CEM(1,15) | none | ELE_LOOSE_SH_T(1,20) |
| E1_SHT20 | CEM(1,11) | none | ELE_NLV_SHT(1,20) |
| E2_SHT20 | CEM(2,6) | none | ELE_NLV_SHT(1,20) |
| E3_SHT20 | CEM(1,9)CEM(2,3) | none | ELE_NLV_SHT(1,20) |
| E1_SH30 | CEM(1,11) | none | ELE_NLV_SH(1,30) |

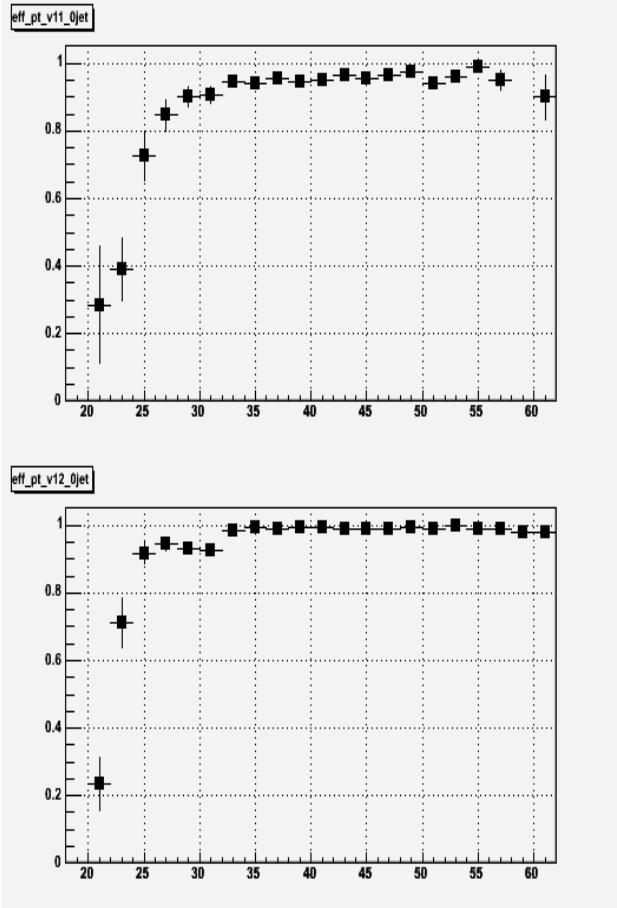
→ Trigger efficiencies based on tag-and-probe:

- Using Z candidate events with inv mass between 70GeV and 110GeV
- Both Z candidate electron are considered as possible tags
- An electron becomes a tag if it has a matched track and passes trigger requirements for at least one unprescaled trigger in the trigger combination
- To pass a trigger's requirement, an electron must have a matching trigger object at each level which passes all cuts for the corresponding trigger
- Matching requirements: L1, L2, L3 $dR < 0.4$

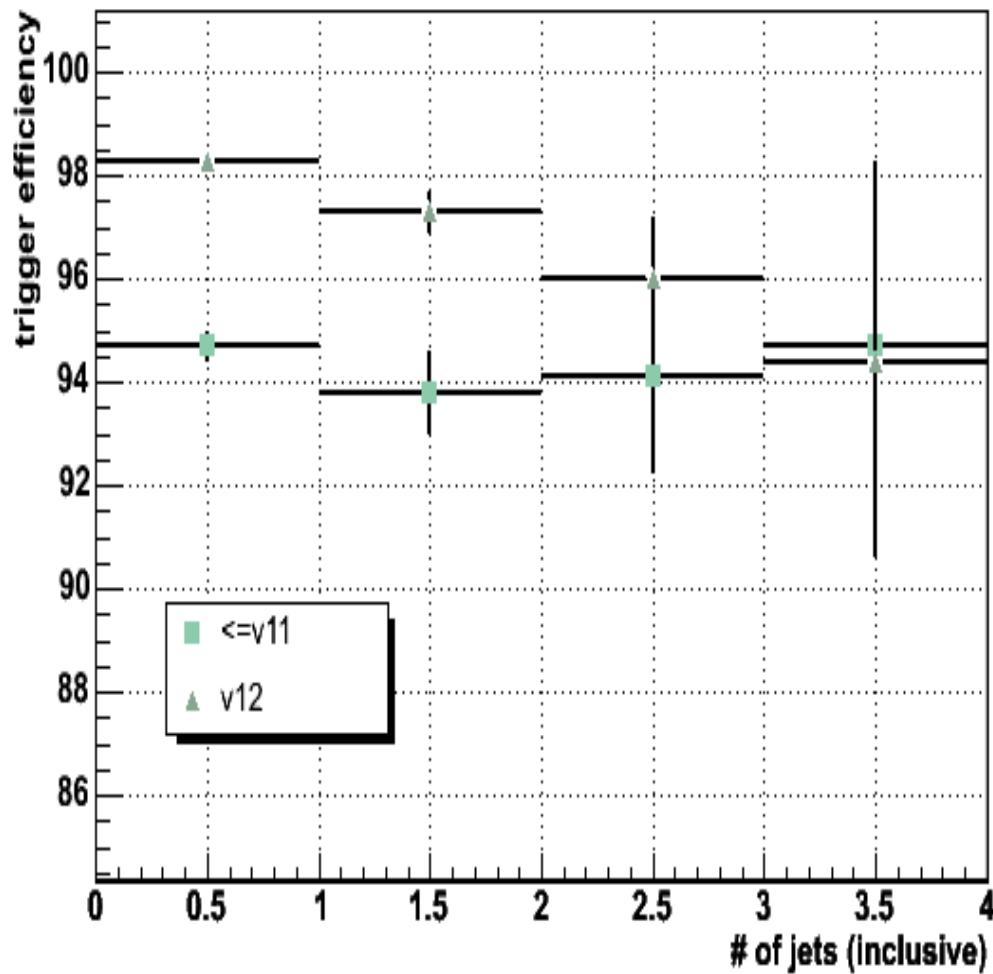


Trigger Efficiencies

Trigger turn-ons for pre-v12 (top) and v12 (bottom) trigger combination for $Z(\ell\ell) + X$ sample:



Averaged Trigger Efficiencies vs Jet Multiplicity



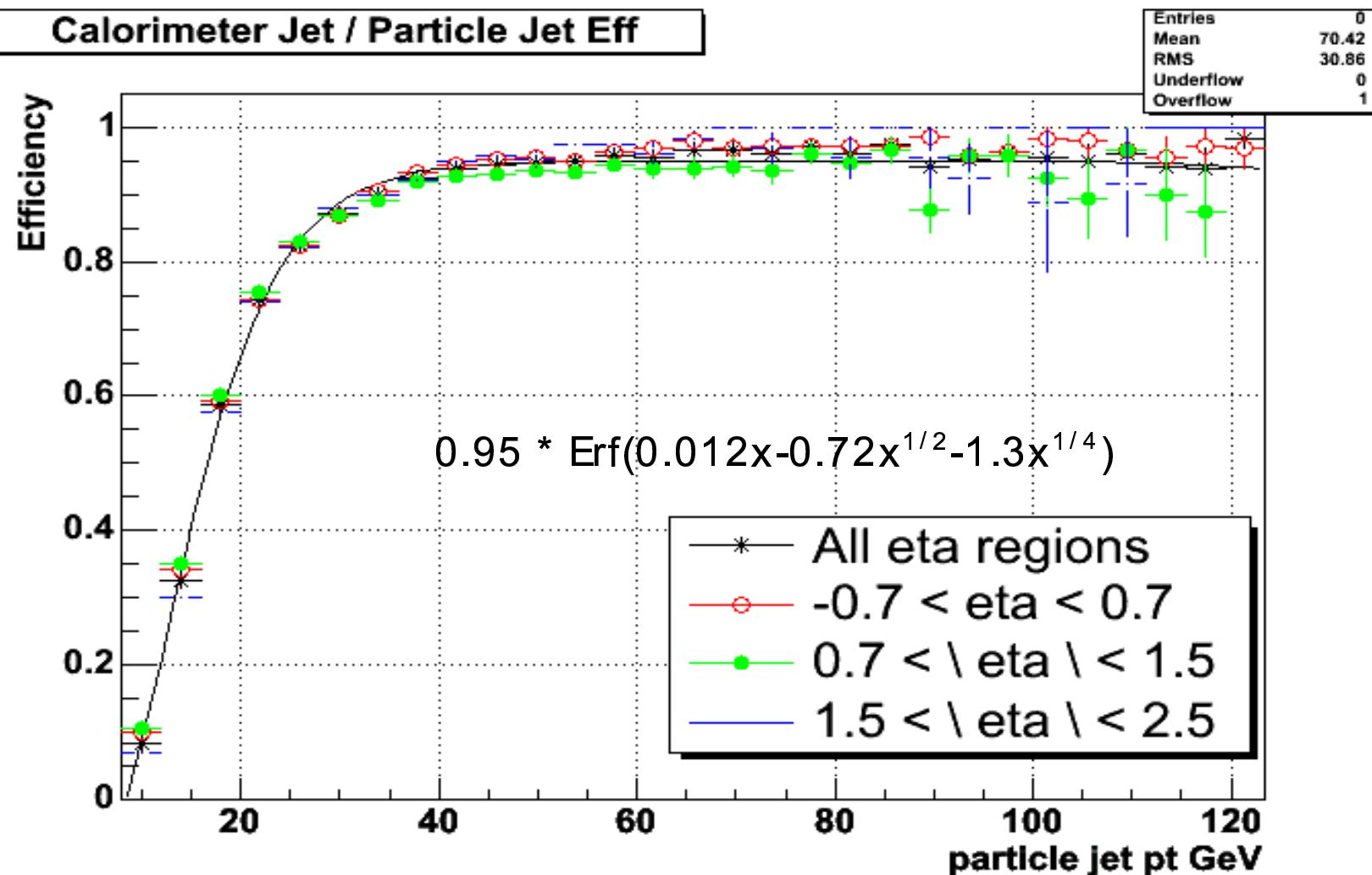
Jet Reconstruction Efficiencies



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Jet Reconstruction Efficiencies (James Heinmiller)

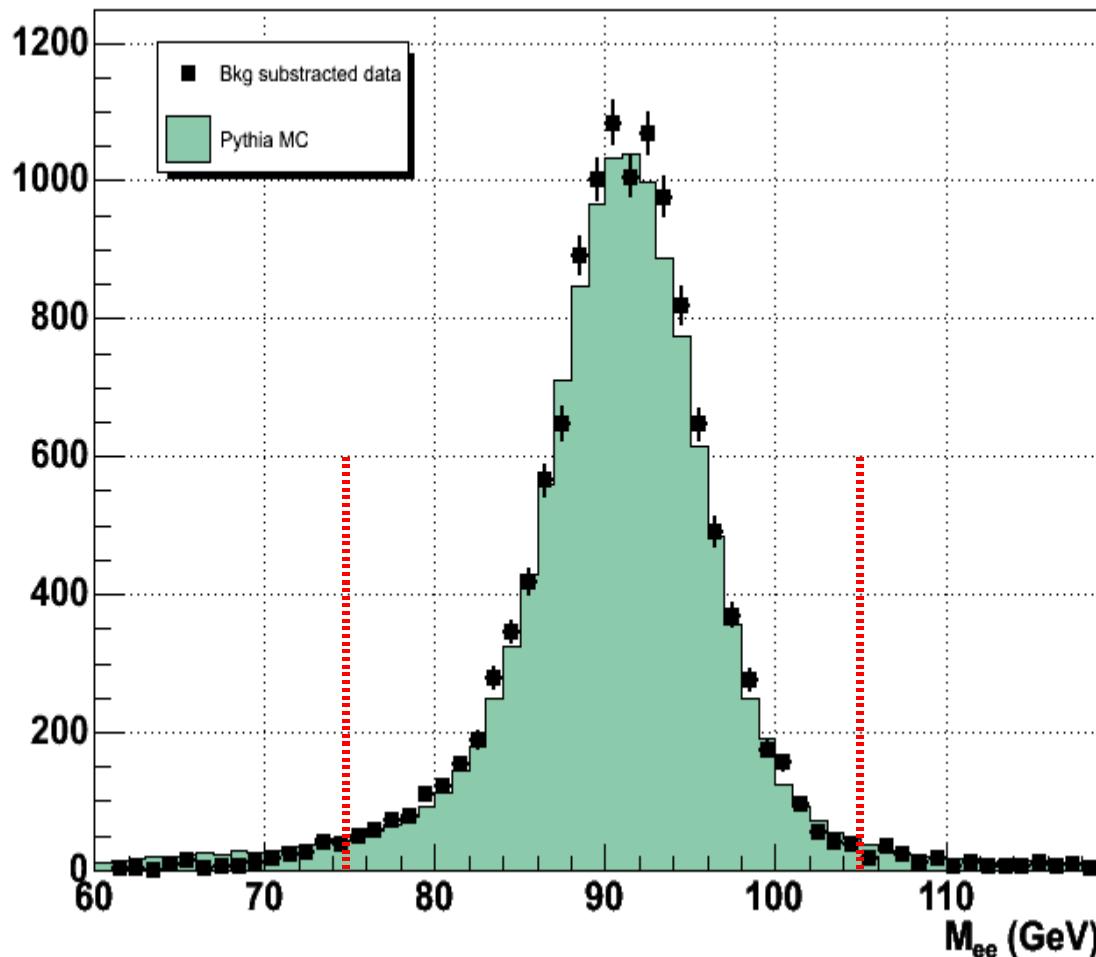


Data vs MC Comparisons



Z peak (≥ 0 Jets)

dilem invariant mass (1 track, ≥ 0 jets)



- 12k Z candidates
- Mass = (91.18 ± 0.05) GeV
- Width = (3.84 ± 0.05) GeV



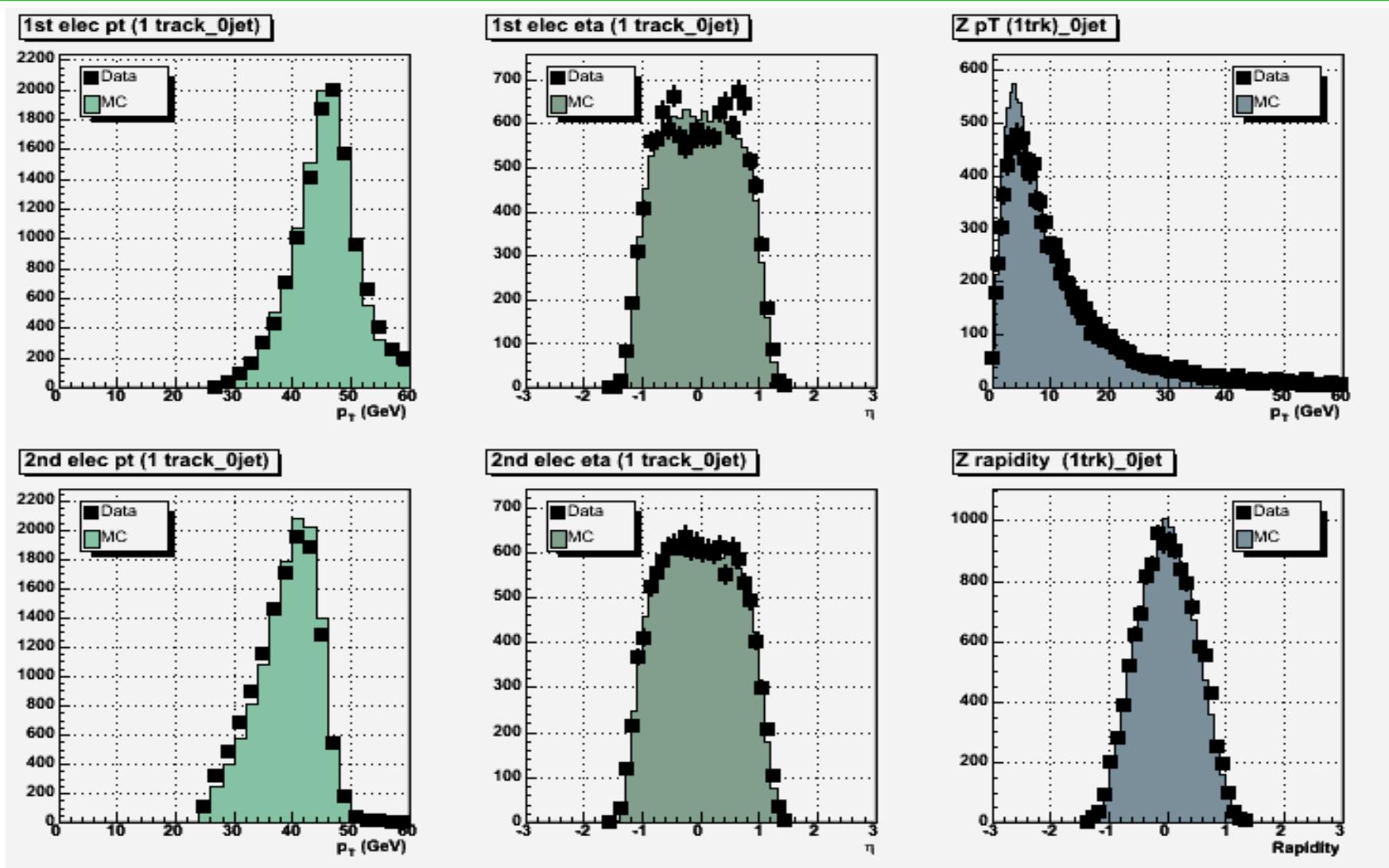
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Z electron distributions (≥ 0 Jets)



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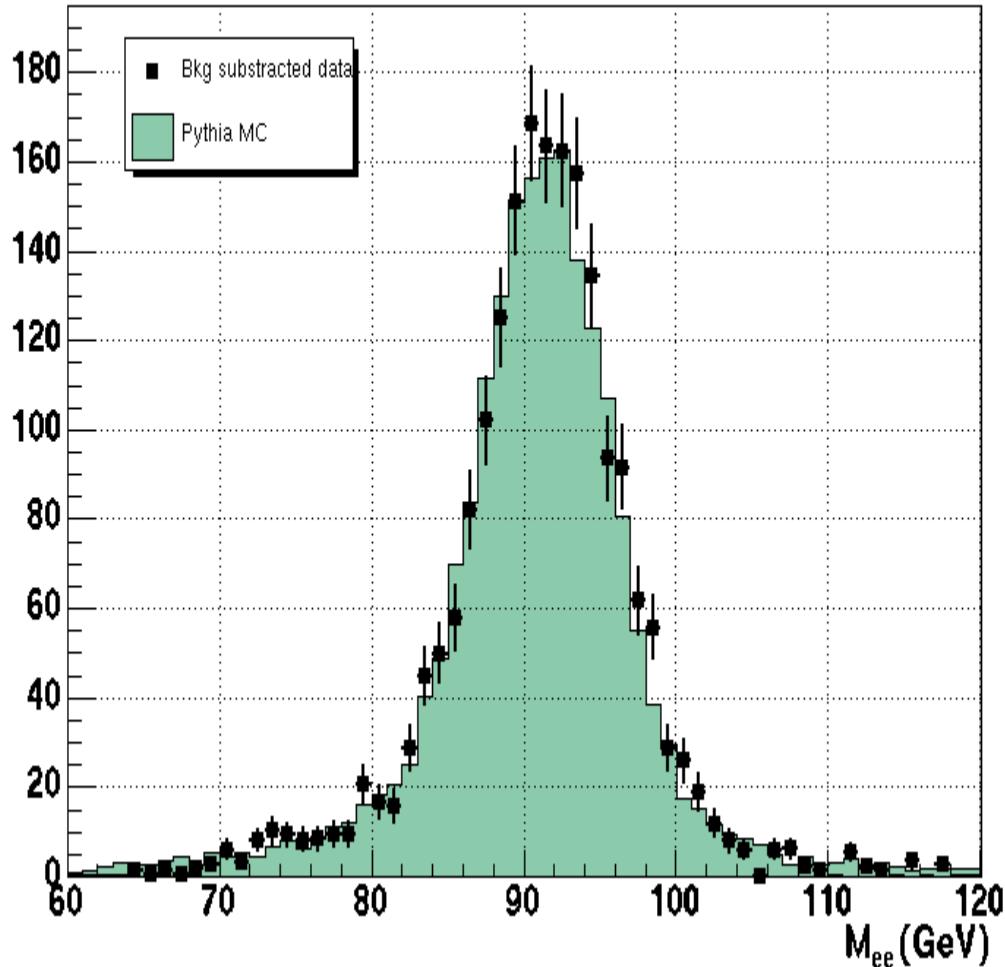
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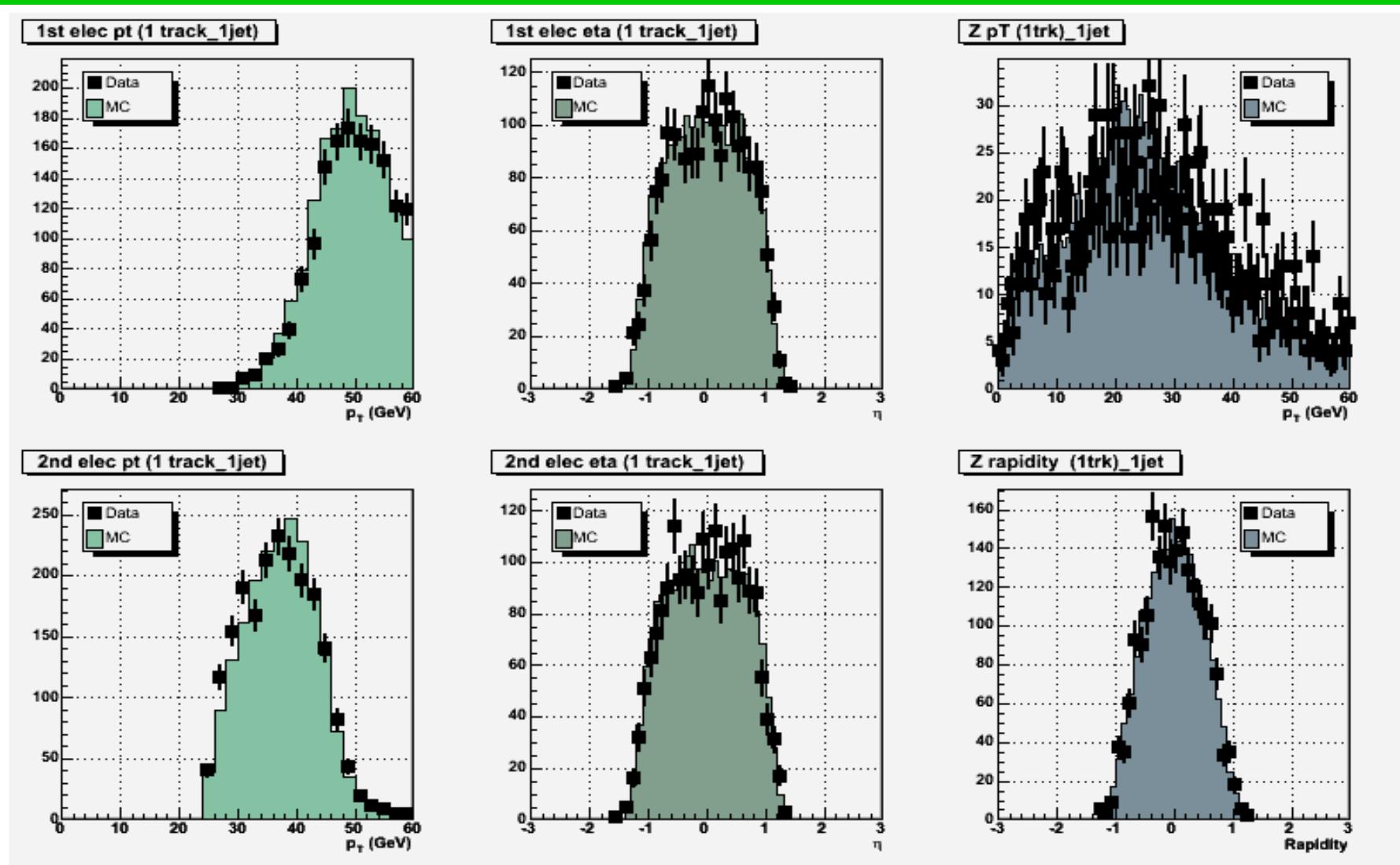
Z peak (≥ 1 Jets)

dilem invariant mass (1 track, ≥ 1 jets)



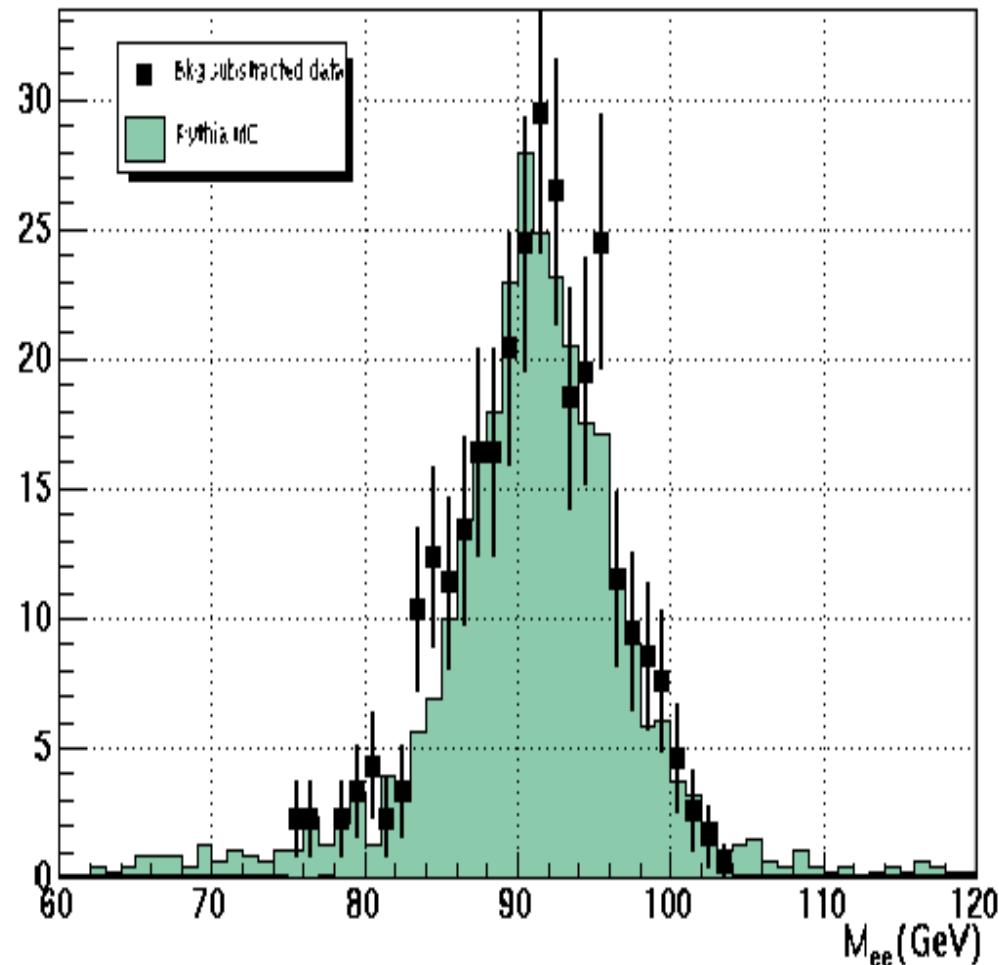
- 2k Z candidates
- Mass = (91.48 ± 0.12) GeV
- Width = (3.89 ± 0.13) GeV

Z electron distributions (≥ 1 Jets)



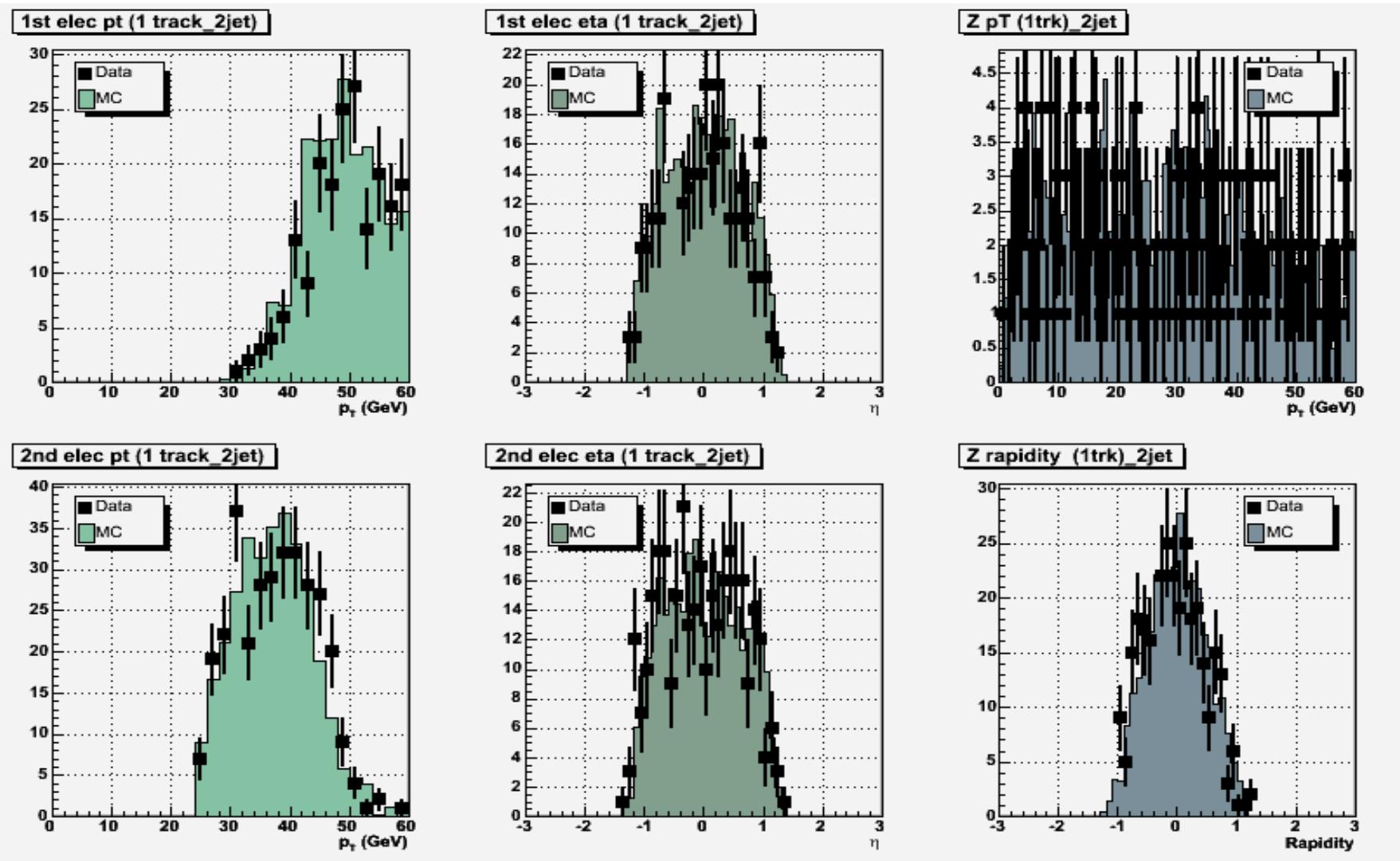
Z peak (≥ 2 Jets)

dilepton invariant mass (1 track, ≥ 2 jets)



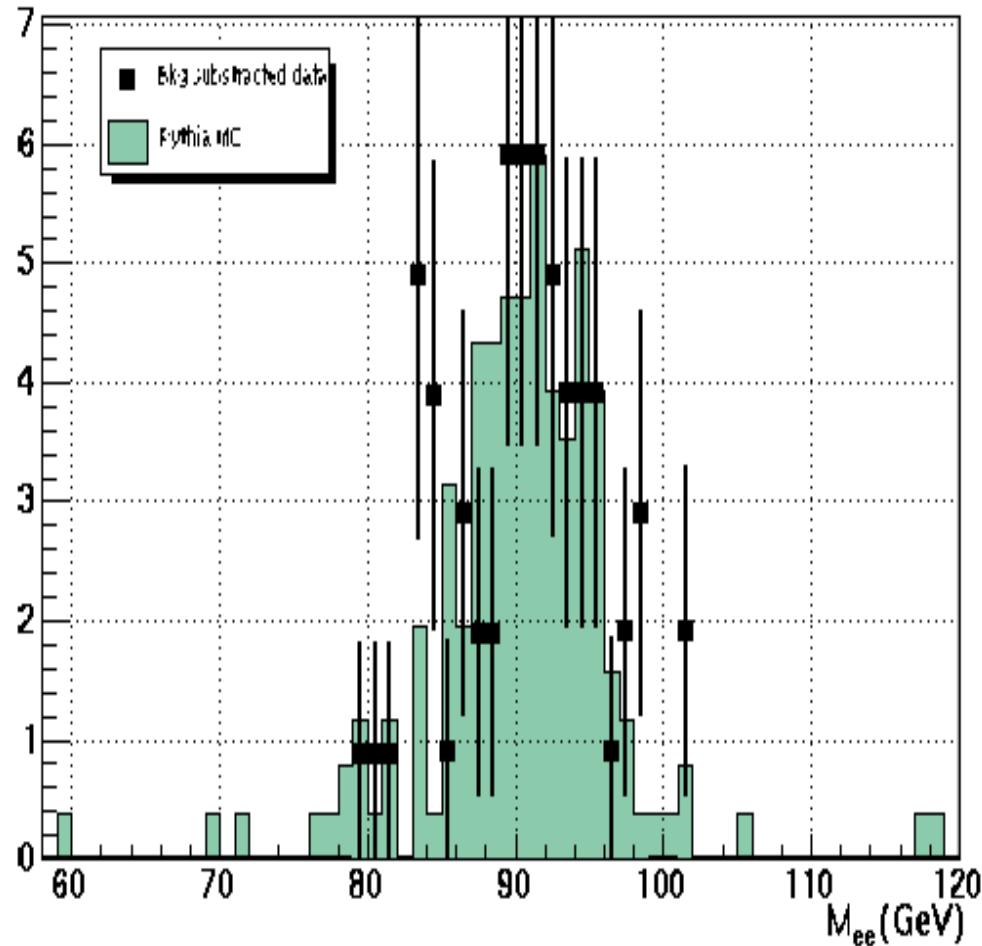
- 300 Z candidates
- Mass = (91.30 ± 0.33) GeV
- Width = (4.20 ± 0.30) GeV

Z electron distributions (≥ 2 Jets)



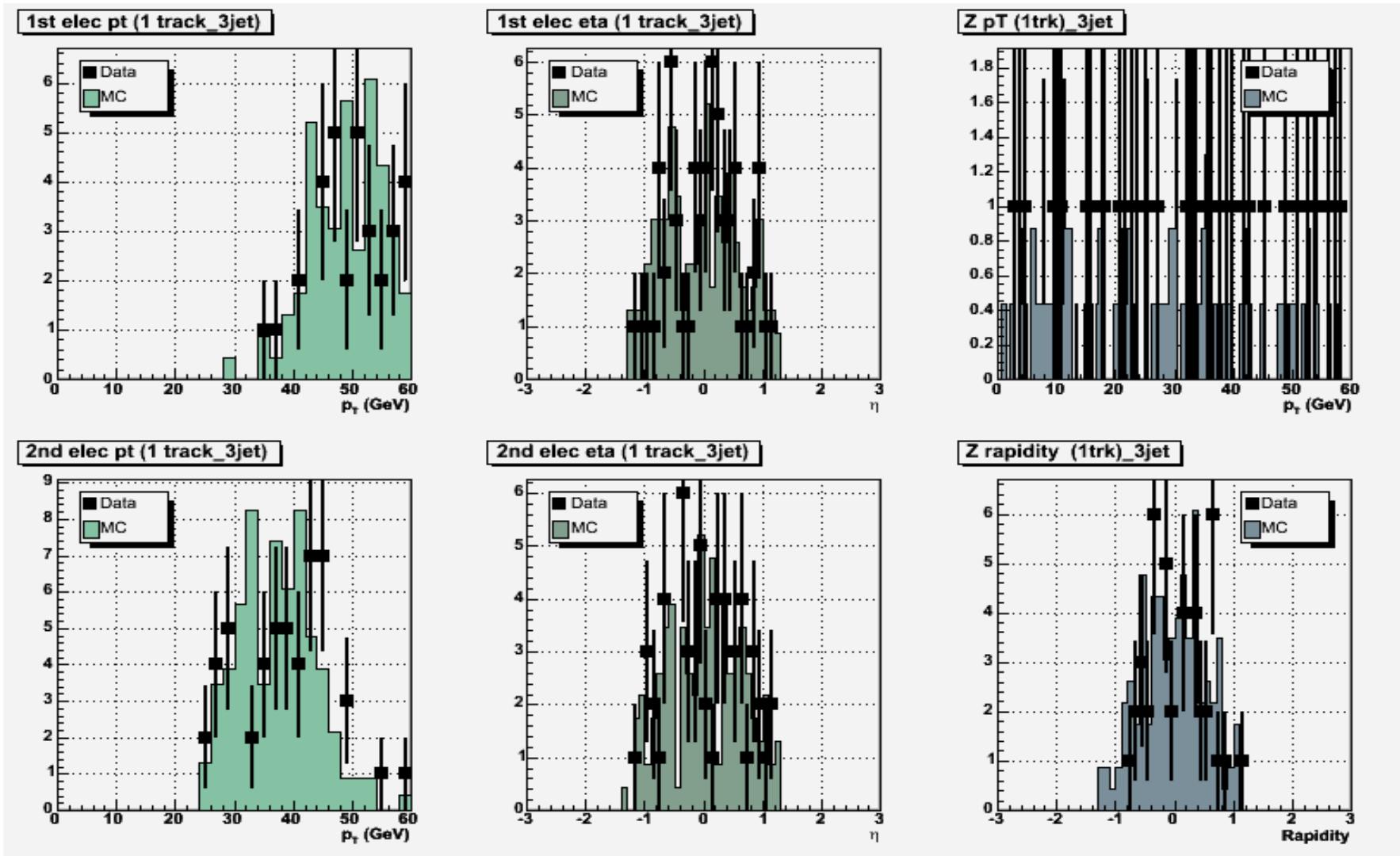
Z peak (≥ 3 Jets)

dilem invariant mass (1 track, ≥ 3 jets)



- 60 Z candidates
- Mass = (91.75 ± 0.70) GeV
- Width = (4.21 ± 0.62) GeV

Z electron distributions (≥ 3 Jets)



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todo

- Produce final set of corrections
- Acceptance vs jet multiplicity (fix MC Z pT to match data)
- Calculate smeared xsection vs jet multiplicity
- Unsmear xsection to particle level
- Study closure in MC (going from smeared to unsmeared xsection)
- Study systematics
- Write note

